The Science Teacher

APRIL

1941

Volume VIII

Number [illegible]

Published
October
December
February
April

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A National Service Journal

The Science Teacher

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VOLUME VIII — APRIL, 1941 — NUMBER 2

Adjustment for Individual Differences

MARK W. DELZELL

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INDIVIDUAL differences in the sciences may be handled in a number of ways. The ways most commonly used would include the use of drill materials, special coaching, differentiated assignments, vocabulary study, supplementary reading materials, exemption from certain assignments, special reports, individual or group field trips, special collections, science club work, construction and care of equipment including visual aids, utilization of resources in the home and community, special training in habits of study, et cetera. This article proposes to deal with this problem through the use of out-of-the-classroom projects or experiences.

Out-of-the-classroom projects are often a truer measure of the resourcefulness of the teacher than any other factor or combination of factors. We have all known teachers who have a pleasant classroom situation. Everyone appears happy, progress is made from point to point during the class hour, but at the close of the period the subject becomes more or less of a closed book in the students' minds until class opens the next day. How encouraging it is when a parent approaches a teacher with the remark that "last night at the dinner table my boy was telling us about . . . (the particular activity of that day's science class)."

IT SEEMS we too often fail to teach for any immediate turnover. It's "You'll need this in a course next year" or "When you go to college this will come in handy" or "This point will be of value to you when purchasing a mechanical refrigerator" (in 7, 8, or 10 years?).

Worse yet is the situation in which the learning of the material becomes an end in itself, a satisfaction in "Well, that's learned." Instead, should we not consider the learning in high school as a springboard into many immediate avenues of expression in out-of-the-classroom experiences?

WE HAVE the teacher who feels if a good job of stimulating interest in a topic is done in the classroom, enough of the students will utilize that material in activities outside of class. The ones that do so will do it naturally and voluntarily — the ones that don't probably shouldn't anyway. It is somewhat difficult to accept this philosophy. If left to happenstance, the teacher certainly is not looking to individual differences. Is it not possible to tie up everyday school learning in the sciences with immediate out-of-classroom activities for a good majority of the pupils? The degree to which students undertake such work might be an index of the practicability of a science course. Athletic coaches have stated that they expect their football players during football season to eat football, sleep football, and talk football. Can we expect to keep our science students up to such a pitch concerning science? There is a surprising number of photography "bugs," radio "hams," and soil-less plant "maniacs" whose initial interest in the hobby was started in a science class.

THE ABOVE mentioned types of out-of-door science subjects, together with the amateur bureau director, the taxidermist, the model airplane builder, the home chemist, and the specimen collector make up the special interest group. This minority is concerned with relatively long-time projects. These long-time projects fill a place in the program, but it is the problem-by-problem carry-over into immediate out-of-the-classroom experiences that can reach the great majority of science students.

The possible everyday out-of-classroom experiences is a way of measuring the value of a unit to a high school science group. If not any, or only a very few, such experiences are possible in teaching a topic, there may be considerable question as to the value of the topic for general education. We should be able to find applications outside the classroom in the student's own life. If they can't be found during the student's school life, what are the chances that they will be found by the student five or ten or fifteen years hence? We have a much better chance of obtaining transfer under the direction of the teacher at the time the topic is taught than we have of a long range transfer without guidance.

THE DIFFERENCE between the long-time projects and those for immediate application may be shown by example. A number of the long carry-over type have been indicated above. For contrast, some of the out-of-classroom activities emphasized in this article are given. The following suggestions are neither novel nor unique and have been used numerous times by alert secondary school science teachers. They are offered merely for the purpose of directing attention. In biology, such would be the study of menus from local restaurants for calorie and vitamin count, an exhibit of shoes by the local shoe store for the application of the study of the care of the feet, the study of methods of preserving food in the community (home canning, refrigeration, quick-freezing, dried food products, et cetera) and a check on the bacteria count in samples of drinking water from various sources.

In chemistry, the study of soaps used in the homes for the presence of caustic materials, the analysis of crank case drainings, the study of soil samples taken in the community, the checking of the hardness of water samples, the preparation of a chemical garden, the analysis of samples from the students' homes of vinegar for per cent of acetic acid, and the collection of oxides found in the community would be among the activities possible in this subject.

Physics offers an avenue to many projects of this nature including the measurement of the intensity of light in the various rooms and parts of rooms in the students' homes, the comparison of the fuel consumption day by day in the home with weather conditions, the determination of the relative humidity in the home and the working out of means for correction, the examination of the working of elevators in a local office building, and determination of the freezing points of solutions of commercial anti-freeze products sold locally. The more a teacher works with the possibilities of such activities, the more activities the teacher will locate. The number available is extensive and the degree of difficulty is as varied as the interests and abilities of the students. It becomes a rich source of material for answering the problem of individual differences in the high school science courses.

EACH SCIENCE teacher in planning the teaching of a problem immediately lines up text book assignments, appropriate laboratory experiments, visual aid materials, and possible field trips. But how many times do we teachers arrange for related out-of-classroom experiences other than field trips for a teaching problem? These experiences should be

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The Insect and Human Welfare II

JOHN E. FRALEY

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TOO OFTEN is the injurious side of insects stressed and too little is the beneficial value of insects realized. In the April 1940 issue of The Science Teacher there appeared a paper by this author under the caption "The Insect and Human Welfare," wherein the negative side of insects was emphasized. Under the caption of the present paper, an attempt will be made to reveal the beneficial qualities of insects, which is too often overlooked.

Let us assume briefly that Nature could press a button which would instantly exterminate all the insects from the face of the earth. The question which would immediately present itself is, just how would this complete extermination affect man? An answer that has not been truly weighed and thought through would undoubtedly infer that this complete extermination would be a good thing for man. It would not be necessary to think of means of exterminating such insects as bedbugs, mosquitoes, house flies, lice, fleas, and others. It would relieve all worry from insect stings such as would be received from the bee, the wasp, the hornet, or other Hymenopterous or Dipterous insects. Further, it would not be necessary to give thought to dreaded insect-borne diseases such as sleeping sickness, malaria, typhoid fever, filiariasis, and others. This, on the surface, would seem to be a boon to humanity, as apparently all of man's insect worries would be over. It is the purpose of this paper to contend that man's worries with such an extermination would just begin from that point. It further contends that it is utterly impossible for man to exist without the insect. Let us consider the beneficial qualities of insects in their various relationships.

The Insect and the Insect:

MANY INSECTS that now exist are of the strictly carniverous type, or nearly so. This, of course, means that they feed upon other animals for their sustenance. Records now prove that there are many insects that feed almost solely upon other insects. The ground beetle, of the family Carabidae, is truly such an insect. The tiger beetles, of the family Cicindelidae, are others which feed largely upon other insects. With very rare exceptions, the ground beetle is considered very beneficial to man, for he annually destroys many thousands of injurious insects. The same is true of the tiger beetle, and is also somewhat true of the water beetle families, including such families as the Hydrophilidae, the Dytiscidae, and the Gyrinidae. It has been said by various scientists that the best control for the injurious insects is Nature herself, meaning, of course, that such natural factors as the weather, natural barriers, climatic conditions, and the predaciousness of other insects themselves, are man's greatest control of the injurious insects. It would not be out of order to mention the value that the silk worm has to mankind, in this instance, the larvae of the moth, Bombyx. The larvae secretes a fluid which hardens upon exposure to the air, from which the worm spins its cocoon. The silk from this cocoon is unraveled and used commercially in the manufacture of real silk. In value, the silk produced by this little insect reaches a figure of near five hundred million dollars a year. Metcalf and Flint are responsible for the statement that it requires more than twenty-five thousand cocoons and the consumption of about a ton of mulberry leaves to make a pound of silk.

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THE SCIENCE TEACHER

201 North School Street, Normal, Illinois

A Journal of
The Illinois Association of Chemistry Teachers
The Illinois Biology Teachers' Association
Indiana High School Chemistry Teachers' Association
Texas Science Teachers' Association
And Serving Other Science Associations

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Entered as second-class matter January 30, 1940, at the post office at Normal, Illinois, under the Act of March 3, 1879.

Subscription rates: In the United States, $1.00 per year, or $1.75 for two years

SUMMER CONFERENCE IN PHYSICAL SCIENCE

A LAND MARK in association activity for science teachers in Illinois is the Summer Conference on Improvement of Teaching of the Physical Sciences sponsored by the Illinois Association of Chemistry Teachers under the leadership of Mr. Ray Soliday of Oak Park, president of the association. It is to be held at the University of Illinois, July 14-18.

A unique feature of the conference is that is will be planned and managed entirely by teachers, solely in order to work toward the solution of their common problems. A tentative program, based on a questionnaire sent to teachers, has been worked out with the University committee cooperating with the association. However, the program will not be planned finally until the conference opens so that the people who attend may plan their activities. It appears at present that emphasis will develop upon the highly practical aspects of teaching problems, such as the best methods of serving the actual needs of each community in fields of health, vocation and vocational guidance, and soil testing. Many teachers will present their views regarding the goals and the methods most desirable, and will describe their most successful methods. There will be a few university experts, including Professor Curtis of the University of Michigan. Some attention may be given to national movements, such as the work of the National Committee on Science Teaching.

OUR FRONTISPIECE

For our frontispiece we are indebted to Mr. George Carothers, Roswell High School, Roswell, New Mexico. It represents one of the exhibits of their science fair. A pictured story of the fair will appear in our October issue. Mr. Carothers is deserving of much credit for the good work he is doing.

Summer Growth and Winter Shrinkage

JOHN C. CHIDDIX
Editorial
Community High School — Normal, Illinois

AS SCIENCE teachers, shall we look ourselves squarely in the face and ask a fair question—"Is professional growth a considered part of my personal program?" At this season we get so busy checking up on students and on laboratory supplies that we often do not check on ourselves. We do plan ahead, yes. We plan for outings and pleasures along the way and even for retirement. But in all honesty, we do often forget to plan for our educational advancement.

ADMINISTRATORS recognize the need for professional advancement of teachers with the result that many school systems require teachers to attend summer school at least once in a period of three to five years and in some cases pay a bonus for doing so. The summer growth thus assured offsets the tendency for winter shrinkage. Not only is the time spent in school of benefit to the school, but also to the teacher. For the latter, the summer school is a real asset, and can be cited advantageously as convincing proof of being well informed and abreast of modern methods should a change to a better position be desired.

What further means is there for educational advancement? Certainly professional books and teachers' journals belong on every teacher's desk. Their value is generally recognized in keeping up with current thought. This does not mean that we should attempt everything that others suggest. Rather, from these sources we do get ideas from which we may want to choose and adapt to our own situations.

AGAIN, SCIENCE teachers' associations can be and often are a splendid means of bringing about educational growth — not that we learn everything that is new in one or two meetings a year, but we are faced with new ideas and stimulated to pursue them further through reading and talking with other teachers. Committee work on educational problems is especially worth while. Nothing is better than a good round table discussion by active teachers. Teachers need to get into the discussion, make themselves known, and talk together after the meeting. The more they participate, the more worthwhile will they find association meetings.

Another feature that is becoming prominent is the summer conference sponsored by the more active and stronger science teachers' associations. These are usually organized in cooperation with some state university or other educational institution and may last from two or three days to a week.

Recently it has been brought to our attention that both Oklahoma and Illinois are initiating a summer conference for teachers for the first time. The one in Illinois is being initiated by the Illinois Association of Chemistry Teachers in cooperation with the University of Illinois. This action is to be commended and deserves to be studied for its possibilities in other states.

THE VALUES that come to teachers through summer conferences depends to a great extent on the initiative shown by teachers in getting the type of program presented that is of real practical value. Fortunately for the teachers, most university staffs appear willing to provide a program as desired. With good planning in relation to the real needs of teachers an effective program of considerable worth for the educational advancement of teachers will result.

Building a Tesla Coil

WALTER S. HIRSCH

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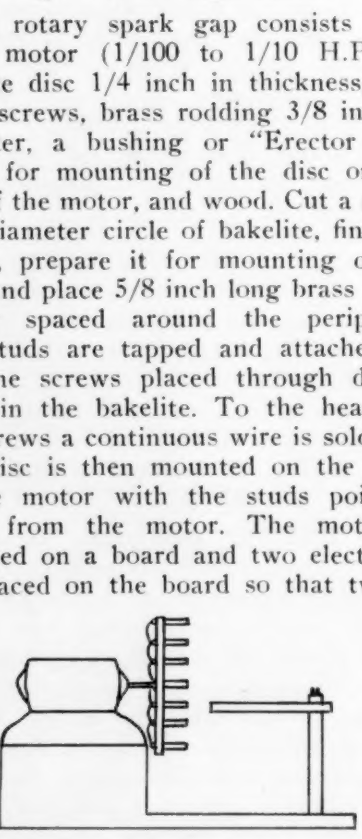
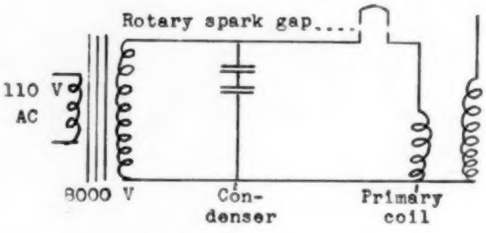
This apparatus was demonstrated at the Demonstration Meeting of the Association of Laboratory Assistants in the New York City High Schools, held on October 25, 1940, at the College of the City of New York.

WITH THE apparatus here described it is comparatively easy to obtain a high frequency electrical discharge of formidable proportions. The apparatus consists of four main parts: an eight to twelve thousand volt tranformer of the capacity used for neon lights, a rotary spark gap, a large condenser, and a very large primary and secondary coil. The transformer may be easily bought rather than built, and there is usually one in the average science department.

The rotary spark gap consists of a small motor (1/100 to 1/10 H.P.), a bakelite disc 1/4 inch in thickness, machine screws, brass rodding 3/8 inch in diameter, a bushing or "Erector Set" wheel for mounting of the disc on the axle of the motor, and wood. Cut a seven inch diameter circle of bakelite, find the center, prepare it for mounting on an axle, and place 5/8 inch long brass studs evenly spaced around the periphery. The studs are tapped and attached by machine screws placed through drilled holes in the bakelite. To the heads of the screws a continuous wire is soldered. The disc is then mounted on the shaft of the motor with the studs pointing away from the motor. The motor is mounted on a board and two electrodes are placed on the board so that two of



Rotary spark gap apparatus



Wiring diagram for tesla coil

the studs are always facing the two founted electrodes at the same time. The number of studs depends on the speed of the motor. The optimum number of sparks per second should be about 400. Hence a motor running at 2000 revolutions per minute will require 12 studs on the disc. All screw heads are connected together by a No. 18 copper wire soldered to each head.

THE CONDENSER is made by placing alternately glass plates (window glass) and tin, brass, or aluminum foil next to each other into a wooden frame and immersing the frame in transformer oil contained in a battery jar. The tin foil and the glass plates can be made to adhere to each other very securely by using ordinary shellac. Two electrodes, each consisting of alternate strips coming from the plates, stick up above the oil. The glass plates are 8 inches x 10 inches and the tin foil is 3/4 inch shorter on each dimension. The corners of the tin are nicked to avoid sharp points which may give off corona discharges. The battery jar is placed into a wooden box to give it protection.

The main portion of the tesla coil is in two parts. The secondary coil consists of a cardboard carpet cylinder from 6 inches to 8 inches in diameter and 36 inches long, which is shellacked and

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Outline of a Unit on The Kinds of Animals

MARTIN L. GRANT

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A THOROUGHLY scientific system of classification in biology is often difficult to introduce in the grades because of the wealth of morphological detail which may be involved. The following is an attempt to present some of the more important fundamentals of taxonomy without overburdening the treatment with either details or morphology or technical names. While designed for a rural school science and nature study course in the upper grades (7-8), and tried out at that level, it can be, with minor modifications, used in general science courses, and, with additional vocabulary, in high school biology.

A. Specific Objectives.

1. Factual content Information to be secured. Understandings to be developed.
   a. The grouping together of animals into convenient units on the basis of their similarities and differences. There are many sorts of animals; how may the word "animal" be subdivided?
   b. The differences distinguishing the five major groups of backboned animals, namely, fish, frogs, reptiles, birds, and mammals.
   c. The characteristics which the backboned animals have in common, distinguishing them from all other (boneless) animals.
   d. Miscellaneous habits and life-histories of various animals.
2. Appreciations to be realized. Attitudes to be encouraged.
   a. Value of a knowledge of simple principles of classification.
   b. Recognition of the wide variety of forms covered by the word "animal."
   c. Interest in and respect for animal life.
   d. Attitude of curiosity, rather than fear, toward animals.
   e. Recognition of the position of man as a animal.
3. Habits to be acquired. Skills to be developed.
   a. The ability to observe.
   b. The habit of scientifically analyzing materials and facts. Discriminatory ability, concerning the relative importance of random observations.
   c. Reasoning ability, deductive and inductive.

B. Outline.

1. The backboned animals.
   a. Fish.
      1). Live in water.
      2). Breathe air, taken from the water, through gills.
      3). Usually have scales, in an overlapping "shingled" arrangement.
      4). Have fins.
      5). Usually lay soft eggs, in a jelly-like mass.
   b. Frogs.
      1). Live in water as tadpoles, live on land when grown up.
      2). Breathe by means of gills in the tadpole stage; breathe air directly as adults, by means of lungs.
      3). Have a rather smooth skin, without scales or other covering.
      4). Have four legs, with soft toes.
      5). Lay eggs which are much like those of fish.
   c. Reptiles.
      1). Generally live on land, although many kinds swim very well.
      2). Breathe air directly, by means of lungs.

3). Skin usually with scales, which generally do not overlap.
4). Generally have four legs (though snakes and a few others have none), with sharp claws on the toes.
5). Lay stiff (leathery)-shelled eggs, though in some the eggs actually hatch before being laid.

d. Birds.
1). Generally live on land, and fly through the air.
2). Breathe air directly.
3). Skin covered with feathers.
4). Have two legs (with sharp claws) and two wings.
5). Lay eggs with very brittle shells.
6). Are warm-blooded. (The first three groups are cold-blooded).
7). Have no teeth. (All the others have teeth, except turtles.)

e. Mammals.
1). Generally live on land. Very many types can swim.
2). Breathe air directly. Have a diaphragm (which is lacking in all other animals).
3). Skin covered with fur (hair, wool).
4). Generally have four legs (or two legs and two arms), with claws, hoofs, or nails.
5). Give birth to "living" (shell-less) young, which are fed by the mother's milk glands (breast, udder).
6). Are warm-blooded.
7). Have an external ear. (Lacking in the other 4 groups.)

2. Examples of boneless animals. Insects (grasshopper, caterpillar, beetle), spiders, crabs, worms, snails, sponges.
3. Contrast between backboned and boneless animals.

Backboned animals.
a. Have bones.
b. Usually have four limbs.
c. Usually (except frogs) have some type of small structures (fur, feathers, scales) covering the skin.

Boneless animals.
a. Do not have bones, but may have a tough or stony covering.
b. May have many limbs or none at all. (Only rarely with four).
c. Skin is generally bare. (Exceptions: some insects, spiders).

4. Application of these principles of classification.
a. Have the pupils suggest the names of other animals not previously mentioned, and see if they can classify them into the groups listed above.
b. Show pictures of different and strange kinds of animals, and treat similarly. Example: show how the presence of an external ear, as on an armadillo, suggests that the animal is not a reptile, though the skin is scaly, but is a mammal, and therefore could be presumed to be warm-blooded and possess all the other characteristics of mammals.

C. Pupil Activities.
1. Observation and handling of as many types of living animals as can be conveniently brought into the schoolroom, for example: goldfish, frog or toad, tadpole, garter snake, turtle, chicken or pigeon, white rat or rabbit, grasshopper, caterpillar, spider, snail, clam, angleworm,
2. Field trip. Observation of any and all animal life.
3. Observation and study of preserved specimens: mounted birds and mammals, dried insects and snake-skins; preserved worms, etc.
4. Observation and study of charts, mounted pictures, book illustrations.
5. Reading about animals in text and

reference books.

6. Cutting out pictures from newspapers, magazines, etc. Scrap-book making.
7. Individual work.
   a. Visiting neighboring farms, ponds, neighborhood pets, etc., with reports on animals observed.
   b. Reading assignments on the details of structure and life-history of critical animals, such as the alligator.

D. Teaching Procedure.

(As an illustration of method, the section on reptiles can be discussed as follows, after carrying out the pupil activities as listed above:)

"Some of the animals we have looked at are known as 'reptiles.' This word originally meant animals that creep on the ground, in contrast to those which raise their body up off the ground on their legs, as do birds and most mammals. What animals that we have studied are of this type? What other examples can you name? (Turtle, lizard, snake, alligator). Which of these have you seen wild? What others might be found in this county? Do you know of any other reptiles in other parts of the world?

"How do these animals breathe? Do they have gills or lungs? If a turtle wants to rest, where does he do it? Can any of them stay under water indefinitely? Do any snakes live in the water? Have you ever seen a baby alligator?

"Feel this dried snake skin. Can you run your finger easily in both directions along the back? Could you do that on a fish's skin? Could you scrape these scales off with a knife as we did with the fish? What is the difference between the scale arrangement on this snake and on the fish? Notice the scales on the underside of the snake. Is there any difference? Is this more like a fish? What is the reason for this difference on the two surfaces of the snake? We watched the garter snake crawl. How did he do it? What happened when we put him on a smooth piece of glass? Do you think the scales have anything to do with his motion? Can he crawl backwards? Are there any scales on a turtle? How are they different from snake scales? Do you find the same type of scales on both surfaces of the turtle? Can you see the scales on the lizard and the alligator in these pictures? Do they look like fish scales, or like those of snakes and turtles?

"How many legs does a turtle have? How does he use them? How about a lizard? An alligator? A snake? How differently must a snake live, since he has no legs? Suppose you had no arms or legs, could you move as easily as a snake does? Why not? If you were in this relatively helpless condition, what features of the snake might you envy?

(Summarize, as per outline above.) (For the final summary, section 1 of the outline can be very easily made into a large table on the blackboard, with five vertical columns for the groups of vertebrates.)

E. Teaching Aids.

1. Living animals in the classroom. (See Pupil Activities, C 1.)
2. Wild animals, as can be found on a field trip; poultry and domestic animals on a farm; zoo, if available; fresh fish from meat market.
3. Preserved animals.
   a. Mounted birds and mammals.
   b. Dried insects, snake-skins, sea-shells, sponges, etc.
   c. Liquid-preserved (5-8% formalin, or 70% alcohol) worms, etc.
4. Charts and mounted pictures.
5. Book illustrations.
6. Text and reference books.
7. Newspaper and magazine pictures.
8. Scrapbooks, made by previous classes.

Science for Society

EDITED BY JOSEPH SINGERMAN

● A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

Science Versus Life*

ANTON J. CARLSON

Professor Emeritus, University of Chicago   Chicago, Illinois

I AM GRATEFUL for the honor and conscious of the responsibility of speaking to you on this occasion. Many of you are probably disappointed that my theme is not one in which I may claim special experience and competence. But I felt that this is not the time and place to display one's personal wares, the special minutiae of our common endeavor. I have chosen the harder way of thinking aloud, perhaps neither wisely nor well, on a problem of deep concern to all scientists and all other citizens. In so doing, it may be that the apparent urgency of the problem obscured the factor of personal incompetence. But I assure you that this eclipse is not total. Should I bore my seniors, seniors in experience, wisdom and years, may I suggest that perchance there is a percipitate, even from folly; and should I exasperate our "young men in a hurry," may I remind them that the general education of the scientist-citizen is incomplete, even at the age of three score and ten.

WHEN THE hurricane strikes ships at sea, frail hulls founder, while the crews of sturdier craft experience anxiety, if not panic, and are for a time deflected from their course by the temporary violence of wind and waves. But they ultimately make their goal, thanks to human courage, the compass, and the fixed stars. Hurricanes, man made, have struck human society, and its institutions, from time to time throughout recorded history. We call them war. The world is now in the midst of one such period of violence, labeled "the worst," because human memory is short and even yesterday's experience is less vivid than that of today. There is anxiety and fear, if not panic, aboard. When storm clouds cover the heavens, men of little understanding question the compass of science, fear that the stars of rectitude will guide no more, and with scant hope drift with the violent wind. The compass of science is not only questioned, but it is charged that this very compass has led us into the hurricane, that science is in conflict with society. So I propose to address myself to these questions: Is our age led or dominated by science? Is science in conflict with the best interest of society? Is it science and the scientific method that lead nations into war? Only last year a British scholar said: "In Europe today it is rather dangerous to ask questions it is much safer to discuss how a question should be asked." Today this danger is by no means confined to Europe. But as I read the human record in mud, and rocks, and ancient ruins, on tablets of clay, in scratches on stones, papyrus, and paper, I think I discern evidence of the ascent of man, through asking all kinds of questions at all times, and seeking the answers by the best methods of the age. If we do less, we admit that science and civilization is a blind alley in human evolution.

NOT AN AGE OF SCIENCE

IS OURS the Age of Science? Or rather, in what sense is ours the Age of Science? An eminent physicist recently said, in this very city (Philadelphia):

*Annual Sigma Xi lecture, Philadelphia, Dec. 30, 1940. Courtesy Sigma Xi Quarterly.

"In no previous time in human history has life and thinking been so greatly influenced by science as it is today." This is undoubtedly true, but does that alone make ours the Age of Science? I think not. Those who, accusingly or proudly, describe our times as the Age of Science usually cite as evidence the modern aspects of man's inhumanity to man, or the numerous practical applications of the discoveries in physics, chemistry, geology, biology and medicine during the last hundred years, such as the steam and gas engine, the telegraph, the telephone, the airplane, the radio, modern surgery, fair control of infectious disease, modern sanitation, and many other inventions and measures that contribute to the convenience, the efficiency, the health, the comfort, and the happiness of modern life. It is true that science, during the last hundred years, has increased enormously our understanding of the nature of the world and the nature of man, and with that greater understanding has come greater control of the forces that act in man and in his environment. But fundamental discoveries in science are the achievement of but a few people. The practical inventions based on these discoveries are also the work of a few men, speaking relatively. And the physical and chemical inventions are mostly gadgets that merely modify our tempo and external mode of living. I contend, and I think I will be able to prove to you, that the great mass of the people of our age, the rank and file of men and women of our day, even in the most enlightened countries, in their thinking and in their motivation are nearly as untouched by the spirit of science and as innocent of the understanding of science as was the "Peking Man" of a million years ago.

THE MODERN man adjusts to an environment greatly modified by the scientific efforts of the few. The "Peking Man," we may assume, adjusted himself as best he could to nature in the raw. A span of about a million years separate the two. And yet the two are about equally innocent of science, in the sense of the spirit and the method of science as part of their way of life. For science is more than inventions, more than gadgets, however useful and important they be. Science is even more than the discovery and correlation of new facts, new laws of nature. The greatest thing in science is the scientific method, controlled and rechecked observations and experiments, objectively recorded, and interpreted with absolute honesty and without fear or favor. Science in this sense has as yet scarcely touched the common man, or his leaders. The character of human society in any age is determined by man's thinking, motivation, and behavior rather than by external gadgets. The erroneous assumption that ours is the Age of Science, or the very limited sense in which this is true, has led many people to charge to science some of the follies and failures, some of the violence, the brutalities, the suffering, the confusion throughout the world in recent years. Some of these people tell us that "science has failed," that we should declare "a moratorium on science." As if we now understood all things; as if real understanding is harmful; as if we should seal the book of scientific knowledge of today against the generation of tomorrow. People who talk thus, who advise thus, cannot understand either the spirit or the method of science. We cannot afford to declare a moratorium on honesty, on integrity, on objectivity, on experimentation, for that would take us straight back to the jungle. The way of science is away from the jungle, away from its violence and fears. If the way of sciences at times, such as the present, seems obscure and even dangerous, that is due to too little, not too much, understanding of the nature of man and our universe, and to the further fact that we do not or are not permitted to follow the light of science we now possess.

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Science Clubs at Work

EDITED BY KARL F. OERLEIN

State Teachers College California, Pennsylvania

A department devoted to the recognition of the splendid work being done by the science club members and their sponsors in the various State Junior Academies of Science. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Dr. Oerlein.

Oklahoma Junior Academy of Science

A Brief History

(Editor's note: Beginning with this issue, this department will devote its entire space to one particular Junior Academy of Science. We begin the series with the Oklahoma Junior Academy of Science. Although among the younger junior academies, it is very active and developing nicely. The assistance of Miss Edith Force, Tulsa, is greatly appreciated.

In the next issue this department will feature the Kansas Junior Academy of Science. Miss Edith Beach will act as assistant editor.)

IN FEBRUARY, 1935, the Oklahoma Academy of Science appointed Miss Edith Force as Director of the High School Relations Committee of the Academy. A temporary organization, "The Association of Science Students of the Oklahoma Academy of Science," was formed. The first annual meeting was held in December, 1936. Such meetings have been held since with student demonstrations and exhibits attended by both students and sponsors. District meetings were organized in four districts, and participation in the spring and fall meetings of the Academy of Science proved stimulating to all. Student officers have been regularly elected by representative delegates from each club.

AT THE SECOND annual meeting in December, 1937, the affiliation with

(Continued on page 34)

Exhibit at Junior Academy of Science Meeting, Tulsa, Oklahoma

Enid High School Biology Club Museum — Oklahoma

Raising Butterflies and Moths as a Hobby*

CHERRIE DONS AND KATHRYN EIMER

Will Rogers High School Students — Tulsa, Oklahoma

MY INTEREST in butterfiies began when my father offered me ten cents a dozen for all cabbage butterflies that I could catch and destroy. I soon learned that I could make an interesting collection. Then I decided to collect butterflies and moths as a hobby. Later, I learned at school that I could raise the larvae and have more perfect specimens. Even though I could not identify the larvae, it was fun to feed them and see what they would do.

*Note: Presented November 23, 1940, Oklahoma Academy of Science, Stillwater, Oklahoma.

In the summer of 1940, when I joined the Field Biology class, sponsored by Miss Edith R. Force, another member and I began to collect larvae so that we might watch them develop. Some of the moth larvae collected were those of the Five-Spotted Hawk Moth, the Io, Polyphemus and Cecropia. The butterfly larvae were the Black Swallow-Tail, Buckeye, Variegated Fritillary, Violet-tip and Monarch.

The caterpillars were kept in separate quart fruit jars with wire tops. The

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Laboratory Epigrams

CARROLL C. HALL

Exchange Instructor, Hollywood High School — Hollywood, California

FIRST AID instruction is an obligation of every laboratory teacher. Treatment of cuts, burns, and the location of the first-aid supplies. Here is a practical way to teach neutralization.

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Keys are a curse in any laboratory. A board two inches wide, and twenty-four inches long and of any thickness, in which are driven one-inch finishing nails will hold the keys for each class. Leave them in the lab!

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Student supplies for class exercises should be conveniently located for them. It cuts down room confusion. Divide the supplies into at least three groups for an average-sized class. A single supply table is no better than none at all.

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Charcoal blocks can be sawed in half. They'll last twice as long. The shortened block can be held in the test tube clamps.

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Pottery trays used for holding large flower pots are excellent for handling concentrated acid bottles. These trays are cheap. Set the acid bottles in the trays on a layer of baking soda.

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Pour, don't dip, is the only way to handle acids. It is the one sure way to prevent contamination. Place all other liquid reagents in small-necked bottles and apply the same rule.

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Hit and run drivers is a good name for students who do not clean up after class.

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COMMUNITY lockers are good ideas. It does away with the key nuisance and promotes good training. Careful planning is needed for an organization of this sort.

Envelopes for unknowns work fine for all except deliquescent salts. Have your students bring in old Sunday School and Church collection envelopes. In a short time you'll have an ample supply. Don't let the minister get wise!

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Hack saw blades are handy tools for laboratory use. Cutting corks, charcoal blocks — or what have you.

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Rubber stoppers stay fresh longer when kept away from air. Put them in glass fruit jars fitted with caps.

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Label everything in the laboratory. Every drawer, bin, cupboard, or continer of every description. It pays big dividends in order and time-saving.

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Locker equipment should be kept at a minimum. Issue special equipment when and as needed. The equipment lists were made out by people who had something to sell or by educators who copied their list from the salesman's.

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Test tube chemistry. High School Chemistry is a test-tube course. Fancy equipment and gadgets are for the research lab. There is plenty for the kids to know in the test tubes. Faraday once wrote a book on "The Chemistry of a Candle."

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Furnish your own light. It is bad practice to furnish matches to high school classes. Let them be responsible for at least that item. Anyway, the girls have plenty of them.

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Keep paper out of student lockers — litmus, because it is soon spoiled, filter paper, because it is wasted. Have a sup-

ply of these materials in proper containers at the side of the room.

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AN INSPECTION trip through the laboratory goes a long way in making the first class sessions a success. It is the one time when safety, clean-up and apparatus instructions can be given full emphasis. Besides, the girls don't know how to operate the fume hood.

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Shelf bottles will stay in place better when both the bottles and their space on the shelf carry duplicate numbers. A calendar will supply the necessary numbers. Cut them out of last year's.

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Sixty-minute laboratory periods usually mean fifty-minute periods when the administrators get through with them. Go through the laboratory manual and weed out the long exercises. One thing done well is worth three pages of rush-order activity.

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Clean-up time means just that. Be regular and enforce it. At least we can develop some good habits.

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Project work is great when it comes straight from the genuine interest of the student and after the fundamentals have been mastered. It is not a grade-padding device.

- - - - -

Contract method in chemistry bears watching. Why not put the entire second semester's work on that basis? Let's give the youngsters a real chance to go on their own.

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A SMOOTH RUNNING laboratory is the result of from one to two hours preparation on the part of the instructor before the session begins. You can read the newspaper after they get started. Don't expect to have a good laboratory if you are getting out the reagents for ten minutes after the class begins.

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Test tubes are the backbone of the high school laboratory. Get good ones.

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Block experiments are essential for the average class group. Arrange to do several related experiments together. Start pupils at the beginning of a session on different jobs. Watch how it aids laboratory order and discipline as well as the traffic to the supply tables.

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Work alone and like it. Chemistry is a one man study. Avoid pair or group experiments whenever possible. The fellow that tells you that the students do just as well, read it out of a Master's Thesis — he never had a laboratory section.

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Micro-chemistry should be watched and studied by every chemistry teacher. There's a lot of good sense in it. Pupils can learn just as much with a thimble-full of reagents as with a bucket-full. Besides, neatness and accuracy is increased.

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Small quantities. Go through all the laboratory manuals and reduce the quantities of reagents called for by one-half. You still have twice too much.

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Time out bell. Have a signal for attention, clean up, etc. The time to show something is when it is to be seen. Get the pupils' attention right now.

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WHERE'S your want list? It hangs in the stock room where it can be used at once. What is it? A plain piece of paper on which you jot down your supply shortages. It stays put until the next requisition.

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Country store tactics are good in the stock room. Always set the oldest supplies forward on the shelves — they'll be used up first.

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Cookbook chemists are made in the laboratory. Fool 'em once in a while.

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Neon Type Signs

A. FRANKLIN FAUST, E. CARLTON MOORE

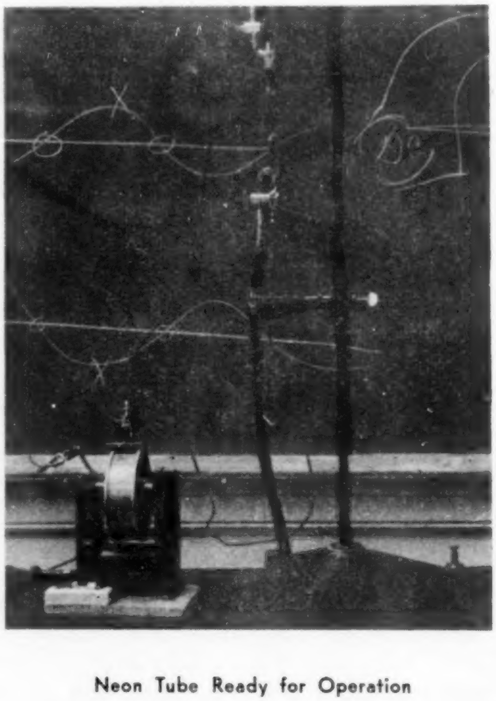
Hempstead High School — Hempstead, New York

NEON TYPE SIGNS have become extremely popular during the past ten years. Even though the neon lamp was first used commercially about 1920, it is surprising how few high school students have any concept of how the light is produced and just how the large variety of colors is obtained.

It is our purpose in this article to trace the origin of this light and to show how the large number of effects produced in our modern signs is obtained. Neon is not the only gas used in signs and this will explain why they are referred to as "neon type signs." We shall endeavor to explain this more fully as we progress in the article.

A German scientist, named Henrich Geissler, discovered, before 1890, that whenever a high voltage was discharged through a rarified gas, a brilliantly colored light could be obtained. These experiments were carried further by William Crooks, the English scientist. By 1895 a large number of physics laboratories carried Geissler tubes of various shapes and sizes, usually from six to twelve inches in length and often made of colored glass. The gas used in the Geissler tube consisted most frequently of air at a pressure of less than ten millimeters. When an ordinary induction coil is discharged through one of these tubes containing air, it will glow with a brilliant crimson color, provided the glass is clear. If the glass is colored, the light will be one that the colored glass can transmit.

THE TRANSITION from the Geissler tube to our neon sign of today can be shown with a very small capital outlay. To do this, it is suggested that you procure a portable tesla coil from any apparatus supply house. This item will cost about ten dollars. Where only limited funds are available, a tesla coil is superior to a transformer because it is safe and its uses are highly flexible. For the next step visit the local neon sign manufacturer. The demand for neon signs being what it is today, there is certain to be one with a few miles of you. He will gladly furnish you with a number of tubes containing samples of neon, argon, helium, mercury vapor, and possibly sodium with a trace of neon. Have with you labels that you can attach to the tubes stating the type and pressure of gas contained in each. If you get a tube with sodium in it, it is necessary to have a trace of neon to act as a "starter," since the sodium consists of metallic sodium which will not ignite without the presence of neon. Each of the tubes should be between 18 and 24 inches long and should contain gas at a pressure of less than 10 milli-



Neon Tube Ready for Operation

meters. These tubes may be fitted with regulation sign terminals if you so desire; in fact, it would be better to insist on the regular terminals if you hope to use a transformer at some future date. In addition to the tubes mentioned, you might suggest that he prepare one mercury tube and one neon tube in each of the several samples of colored glass tubing he may have in stock. An additional tube containing about five cubic centimeters of mercury and some neon gas at about four millimeters pressure will also prove interesting as will be pointed out later. The sign manufacturer will make these tubes for you at a very small cost, or in many cases, he will give them to you without charge.

WE ARE NOW ready to give a very effective and interesting demonstration. Connect the tesla coil to a source of current, grasp firmly the discharge end of the coil in one hand. Now turn on the current. There is no danger in this as is evidenced by the picture of the girl holding the coil in one hand and a vial containing neon gas under a pressure of about five millimeters in the other. To avoid any possible chance of a shock, be sure to grasp the discharge end of the coil before you turn on the current. Your body will now be charged with a high frequency current under a pressure of upwards of 20,000 volts. This currents will travel around the outside of your body, not through it. If some one should touch your clothing, a noticeable spark will be drawn from it. These sparks will not burn the clothing or any portion of the body producing the spark. If you touch or come close to the neon tubes they will glow, each with its distinctive color: neon, red; argon, purple; helium, white, and mercury, a pale blue. You can hold these tubes in your mouth and get the same effect as by touching them. This is the same stunt that the "stream-lined" sword swallower is using at the present time except that he is using a regular neon filled tube connected to current.

Demonstrating a Neon Bulb

If you have seen one of these men working a local fair you will probably remember that he makes a statement about 20,000 volts passing through the tube and stressing the fact that he is doing a wonderful thing by subjecting his body to this immense amount of electricity, when it is actually harmless.

NO DOUBT you will have a few vacuum filled electric or radio bulbs in the laboratory. These may be burned out, as it is the rarified gas that glows and not the filament that produces the light. Hold the bulb in your hand and repeat the process as explained for the tubes and you will again see a distinctive glow, the color depending upon the type of gas in the bulb. This glow may be increased by bringing the base of the bulb in contact with some metal object that is grounded. A more intense light may be produced by bringing the tesla coil directly in contact with the tubes or bulbs. This, however, will prove less spectacular.

A little earlier in the article a tube

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Building Future Citizens Through Science Teaching

J. M. COLEMAN

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(Editor's note: Presented before the science section meeting of the Central Texas State Teachers Association in Austin, Texas, March 7, 1941.)

IT SHOULD BE understood that the appearance of a physician who is specializing in public health on the program of science teachers should not mean that he should bring a group of suggestions for revising the teaching plan of the sciences. To understand the reason for his presence, one must recognize the modern concept of public health activity.

The public has for too great a period of time felt that the function of the public health worker was limited to the times of fear, when they worked under compulsion to combat a threatened epidemic. While this is the spectacular phase of the activity, the real useful function of the public health worker is in routine day by day activity when he is not only attempting to reduce the mortality and morbidity rates, but is making a very definite contribution to the betterment of tomorrow's citizen.

A PUBLIC HEALTH program which is not contributing to the complete growth and development of the children, all the children of the community, is failing in the high task which has been assigned to it.

Public health efforts on the part of the communities in this nation of ours are a relatively new departure and the past few years have been marked by many mistakes. It is only now that the public health worker is coming to recognize his true place in the scheme of society today. The newness is wearing off and public health doctors and nurses and engineers are learning that it is not a command from on high for them to do all things pertaining to the health of the community. They are realizing as programs become centered on the development of the child as a unit that they are simply a necessary part in the program, that there are many individuals and many agencies contributing to the development of the child and that maximum success in this activity can be achieved only through coordination of effort and cooperation in planning.

The program of the State Health Department in relation to the school and the teacher is being built on the philosophy which has been indicated The department is trying to serve as an agency for the enrichment of the curriculum through the provision of information and teaching aids built upon the knowledge of Texas health hazards. This department is making no effort to replace the teacher or to teach in the classroom, since it is recognized that the teacher is equipped for teaching in a manner no doctor, nurse or engineer can hope to achieve. A sincere effort is being made to heed the needs as expressed by teachers for information and material and to prepare such materials in a useful form. Representatives of the department have been available to assist the school in special programs having a public health or personal health connotation.

INSOFAR AS THE actual teaching of health is concerned, the department does not come to the teacher asking that a special course in personal and public health be taught; it asks only that health concepts be integrated into the whole field of teaching. No longer do these workers attempt to lay down rules to govern the action and the life of individuals. The futulity of such rules without positive emphasis and motivation is recognized, and when motivation does exist, there is no need for the rules.

It is important from the public health standpoint that the science teacher shall

never miss the opportunity to tie in the principles of everyday living found in science with the social sciences. The day is passed when we may live as self-sufficient individuals; the people about us constantly exert a greater effect on our lives as the spaces allotted each of us become narrowed. There must be a constant correlation of the hygiene of individual living with the hygiene of community living, for if our children are to become adequate citizens they must recognize the effect that their own personal hygiene will exercise on the people about them, in turn it must be recognized that personal hygiene is no longer adequate to protect the individual. The multiple factors involved in community hygiene must be controlled.

IT IS BELIEVED that the use of the public health activity of the community as a basis for planning field trips will lead to development of this consciousness of the interrelationship which exists between personal and community hygiene. Many of the public health activities lend themselves to science teaching in a particularly suitable way.

The trend in chemistry teaching away from the theoretical general chemistry to the teaching of the chemistry of everyday life seems good and this teaching may be enhanced by the use of such public health activities as the community's efforts to produce and control a safe water supply. The local water plant may be used to advantage for field trips.

Bacteriology may find the local milk shed and milk production a very suitable basis of teaching. There is not only the public health aspect of this, there is also the practical home living feature. The "food handler" schools which are sponsored by the department may be used for obtaining some information with regard to the practical bacteriology of public health.

IT IS BELIEVED that the change in teaching of physiology from the systemic descriptions to the more adequate teaching of personal hygiene holds much promise. Likewise, the curriculum in General Science is making progress through the change from a sampling of theoretical science to an orientation in the sciences of everyday living. General Science affords the best opportunity to integrate all things scientific.

Biology may be used as an extension upward of physiology and it seems well that all teaching in this field should draw the comparative view to the attention of the student, the interrelation of life in various organisms may be of service in teaching. Meat and meat products serve as an example of materials that may be used for teaching, since the transmission of disease from the infected animal to man is not only a problem of public health but one of personal hygiene as well.

Finally, physics may be used to place a human interpretation on the principles of mechanics of the body. Vision, for example, lends itself to study and the resemblance of the eye to a camera affords suitable opportunities for demonstrations in this field.

WITH THIS brief survey of the various sciences making up the field of instruction in the curriculum, an effort has been made to point to single phases where personal and public health may be made a part of the instruction. It is evident in this brief discussion that one cannot discuss all of the possibilities of materials which may lend themselves to study. The primary motive of this discussion has been to direct the attention of the teacher to the possibilities of drawing on this field for teaching material. Public health workers are recognizing the importance of the teacher to the future health of the individual. They are now recognizing that the contributions that the teacher makes go far to insure the complete growth and development of the child. There is need that the teacher realize the full import of this situation and call on this field for whatever needs are manifest.

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A Study of Red Blood Cells of Vertebrates

LOLA LEE DYESS
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Raymond L. Ditmers Scientific Society
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(Editor's note: The author of this paper, Lola Lee Dyess, received the 1940 Science Award of the American Association for the Advancement of Science, being adjudged the outstanding girl scientist of Texas for that year.)

IN MANY ANIMALS the red blood cells are the oxygen carriers. They are responsible for the color of our blood, which in turn imparts a pinkish tinge to healthy and non-suntanned skin. Because of their importance, they are especially interesting to study.

The problem chosen for solution was to examine the red blood cells from the four highest classes of vertebrates — namely, classes amphibia, reptilia, aves and mammalia — and to compare them with each other as to size, shape, and presence or absence of nuclei. The animals from whom blood smears were prepared and studied were toads, turtles, alligators, sparrows, blackbirds, pigeons, chickens, ducks, men, horses, sheep, dogs, and cats.

THE BLOOD CELLS of the experimental animals were measured with an eye-piece micrometer calibrated with a stage micrometer. The size and shape were noted and compared. Lantern slides were prepared from photomicrographic negatives, and these slides were used to illustrate the size, shape, and general structure of the cells. A cardboard chart was made to illustrate the findings in the project. Outline drawings 5000 times natural size were made to show the shapes and relative sizes of the cells thus examined. Nuclei were plainly visible in the red blood cells of amphibians, reptiles, and birds. None of the mammalian red blood cells which were examined in ths study exhibited nuclei.

Blood cells of the amphibia and reptiles were oval, and about twice as large as the average bird cell. The red corpuscles of birds were oval in shape and measured 6.5 microns in width and from 10 to 12.8 microns in length. The red blood cells of birds were about one and one-half times larger than mammalian cells.

EXAMINATION of the red blood cells of the cat, sheep, horse, and man revealed that all were round and ranged in diameter from 3.2 microns in the sheep to 8 microns in the cat. The oval blood cells of the dog measured 4.8 microns in width and 6.4 microns in length.

From these facts, a conclusion may be worded thus:

1) Nuclei are present in the red blood cells of many of the lower vertebrates, but are not present in the red blood cells of mammals that were examined.

2) The red blood cells of each class of vertebrates vary from large oval cells with nuclei in the lower classes to smaller round cells without nuclei in the mammals.

Description of Certain Vertebrate Red Blood Cells

Animal	Shape of Red Corpuscles	Size of Red Corpuscles	Nuclei
Toad	Oval	10 x 12 microns	Present
Turtle	Oval	11 x 13.5 microns	Present
Alligator	Oval	12.8 x 16 microns	Present
Sparrow	Oval	6.5 x 10 microns	Present
Chicken	Oval	6.5 x 10 microns	Present
Blackbird	Oval	6.5 x 12.5 microns	Present
Pigeon	Oval	6.5 x 12.5 microns	Present
Duck	Oval	6.5 x 12.5 microns	Present
Sheep	Round	3.2 microns	Absent
Horse	Round	6 microns	Absent
Man	Round	4 microns	Absent
Cat	Round	8 microns	Absent
Dog	Oval	4.8 x 6.4 microns	Absent

Real interest comes from successful understanding and concentration on an area of thought. It must be distinguished from curiosity, which is fleeting and shallow.

An Activity Program in Biology

W. LEROY MACGOWAN

Supervisor of Biology

Jacksonville, Florida

(The activity program presented in this article is noteworthy in that it is modeled along the lines laid down by the National Committee on Science Teaching of the National Educational Association. Mr. McGowan is a consultant with this group.—Editor.)

ONE ARGUMENT in favor of work-books is that they usually contain more activities than the average class can possibly get done. Left-over activities, too often thrown away as useless, can, if the teacher is willing, be done by the quicker and more energetic pupils for extra credit. This keeps the youngsters out of mischief, offers a challenge to hit on all eight cylinders instead of loafing along on four, gives them a wider range of experience, more valuable because self-chosen, and rewards them not only with better grades, but with the satisfaction of putting through, on their own, projects of their own selection. It is more than possible, too, that activities chosen and carried through independently by individuals can be more valuable to them in developing initiative, self-reliance, and a functional carry-over of interest into the environment, than activities assigned by the teacher to the class as a whole.

While we were experimenting in Jacksonville along these lines, two tendencies appeared. First, students doing extra activities outside the class were apt to show increased interest in their work, and second, other students asked for the privilege of receiving credit for outside work. We continued our experiment, therefore, and over a period of several years we have evolved the program of individual activities here outlined. Since one teacher after another, and later one school after another, has adopted it, this program may prove interesting to biology teachers of other localities.

THE SOUTH is a biologist's paradise. We can make field trips, collect, and work with live material from our environment in any month. Unfortunately for us, most text and work books are written by northern authors for the environments familiar to them, which means that dried or preserved material is called for more often than not during the winter, and that first-hand exploration of the environment is expected to stop with the first severe frosts and not to be resumed until the first red-wing whistles an invitation to come hunt for skunk-cabbage and hepaticas. Many teachers, somehow, don't seem to hear the invitation, but limit their outlook and the experiences of their children within the four walls of their labs. We believe that a high school student cannot be given all the biological experiences he should have, within four walls, and that the kinds of experience that cannot be given inside the lab are too important to omit. Since it has been impossible for us to arrange many class trips to include all pupils, on account of student jobs, transportation and the like, we have come to rely on motivating a program of individual student activities, some of which can be done in lab or library during school time, but most of which have to be done outside of school on the student's own time, on his own initiative. We have found it necessary, therefore, not only to adapt to our own needs the suggestions in texts and work books, but to supplement them with many of our own contriving.

IN THE first place, we have discarded much of the dried and preserved material, and have relegated dissections to the first year of college, except for demonstrations and volunteer dissections. One frog dissection with a good chart is usually adequate for a class, and the time which the students might

have spent on the little cadavers can be put to better use in activities more closely related to their own future interests. Those who need dissection will get it in college. Those who want it now can do it as an individual activity. As for the rest, one doesn't explore the interior of a frog in real life. The student would do better to explore the woods and waters where the frog lives, where he will go in adult life again and again for inspiration, recreation and pleasure, and the study of the frog would do well to develop in him an understanding and appreciation of the creature as a part of its habitat, with which he will often come in contact.

In the same way we have gradually discontinued much that has seemed perfunctory or which is of a technical nature leading only to more advanced work of a technical nature. College courses will take care of that. Our activities are aimed at an understanding and appreciation of the broad aspects of animal and plant life as it relates to the environment and to man. More of function and adjustment, less of anatomy. And for the students, more first-hand manipulation of animals, plants, and things, more choices based on their own needs and interests, more time spent in contact with the out-of-doors and with problems that arise, not from books or from the fertile resources of the teacher, but from their own needs for adjustment.

FINDING any one workbook inadequate, we began to pool our experiences with activities chosen from many sources, invented by ourselves, or suggested by the pupils (double credit if adopted). So far, we have assembled a list of about nine hundred activities which are adapted to our particular situation, and the end of the list is still beyond the horizon. Of course, this number is unnecessarily large, but time will bring about a survival of the fittest. We have developed considerable original material along the line of behavior, of which more later. Our lists, I am sorry, are not available for distribution.

Reasoning that if individual activities are good for some, they might benefit others, we began requiring them of all. This takes motivating on the part of the teacher, but results have been so encouraging that we have finally come to require one outside activity each week from all students. Use of this program and modification of it is optional with each teacher, for teachers usually have to work into the program gradually, and some teachers are more successful than others in motivating the children. Results seem to be worth the effort, as evidenced by the fact that my fellow teachers are willing to go to considerable personal trouble to work up their activity programs, even though they are not required to do so. The consciousness of filling real needs and of helping boys and girls in a practical way is reward enough for any extra outlay in thought, time and effort. One is helping children develop as individuals — an important "must" in a modern program of education.

OF THE SIX individual activities expected from each student in a month (or six weeks), three must deal with the topics in hand; three may be free choice. Three must deal with animals, plants or material and develop skill or promote adjustment; three may be books (limit, one a month), reports and the like. Certain of the three topic activities, sometimes all, may be specified. Once in the swing, very few pupils default; new classes accept the program as a matter of course. We explain that the text and the class work are to guide and summarize their study of biology, which they are to carry on, that to understand animals and plants one must understand their environment, which can't be brought into the school room; this understanding must therefore be based on the students' own observations, experience and contacts.

Each student lists the activity he is

about to undertake in a class notebook kept on the teacher's desk, preferably one at the beginning of each week. Some activities may run on for weeks, some may even have to be carried over from one month to the next. When reports are accepted, the teacher checks and dates the student's entry. Activity work is brought to school for examination and display when practicable, and the teachers make occasional forays into neighborhood back yards to inspect lily ponds, vegetable gardens, hen coops and the like. Parents' signatures accompany reports on activities of the latter sort. That these six activities a month are not too great a burden is shown by the fact that the energetic pupils often exceed this number.

IT IS OUR policy to give credit for as wide a range of experiences as possible which the students may undergo during the school term and the preceding vacation. This enables them to get credit for summer camp activities and merit badges of a biological nature. Difficulties and objections, of course, arise. For instance, our traditional testing programs measure with some degree of definiteness factual knowledge or information gained by students, and perhaps the same might be said of skills, although no test can measure the amount of individual development they signify. But certainly no tests can pretend to measure accurately such complex subtleties as interest and attitudes, or personality growth and adjustment. It is toward these intangibles — understandings, interests, attitudes, and adjustments — as well as toward knowledge and skills, that our activity program is directed. They are much more important than the things to which we can apply a yard stick, yet we find it impossible to measure the worth of our program in the direction of these intangibles. We cannot evaluate our work. For this reason some teachers have disapproved. They want something they can mark 79½% and be done with it. We find ourselves very much in the dark about the functional outcomes of our program. All we can do is to activate curiosity, encourage the youngsters to come to close grips with realities in their environment, and to provide as stimulating an atmosphere as we can for their ponderings and discussions. There certainly is more interest than formerly in the class room, and conferences with former pupils lead us to believe that we are helping boys and girls accomplish more and develop more than we formerly were able to. With these facts in mind, we content ourselves that we and our activity program are on the right track.

TO QUOTE from our activities lists would almost amount to opening books which lie at your own elbow. Many activities, however, have not yet found their way into the texts to any extent. Some of the activities quoted below are not likely to be found at hand; some may seem at first remote from the usual courses in biology. But biology is a broad field, and we believe in digging where our own needs can best be satisfied.

You doubtless sprout seeds and draw the seedlings. So do we. Now, let us add another touch. We suggest then that the children grow dish gardens of citrus seedlings — orange, grapefruit, lemon, or mixed — closely massed. It's worth trying. One will probably learn something new about sprouting seeds. And when the children bring their tiny groves for display, they have the added satisfaction of having created something beautiful which has been enjoyed in their homes and admired by their friends. It is this added touch that ties the activity into the child's life. We think it worth while to combine creative activity with aesthetic worth. Note, too, the value of the family angle.

Perhaps you give credit for the Boy Scout Bird Study merit badge, as we do. Recently we supplemented the feed-

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Some Adolescent Health Needs and How to Meet Them

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(Continued from February issue of The Science Teacher)

Sometimes national or state investigation reports indicate that certain problems need to be stressed. An opportunity to approach the same may not present itself locally. Then other methods of the problem approach may be devised. The following case is typical:

14. The instructor started out the class work by asking some nine or ten pupils: "What kind of soap do you use at home? Why do you use it?" A variety of kinds were named, and a variety of reasons were given as to the prevalence of their usage, the most common one being "because the radio announcer says it is good." "How do you know he is telling the truth?" A heated discussion followed then, leading to the following pupil questions (problems): How can we find out whether he is telling the truth? Why isn't he truthful? Can we make our own tests? Can we compare our results with reports of reliable testers? Who are these testers? Do they test all soaps? Wouldn't it be better if the government tested these articles?

THE WHOLE discussion wound up by the group deciding to bring a bar of the kind of soap commonly used at home, and to test it in class for solubility, alkilinity, grit, costs, etc.; then to compare their results with reliable consumer investigation reports; and finally also to determine the reliability of advertising.[1]

1This took place in Stoughton High School, Stoughton, Wisconsin.

The same method can be used in connection with the evaluation of tooth pastes and powders, face creams, lipsticks, rouges, hair tonics, foods, alkalizers, etc. If the pupils themselves raise the problems, the results are always more effective.

One factor that should be quite obvious to the reader by this time is that the course in functional health cannot become static. Flexibility is absolutely essential if we expect to meet the ever-changing health situations. This year's course may of necessity be quite different from last year's course.

II. Arousing Desirable Attitudes and Establishing Intelligent Practices.

IN ORDER to make health teaching useful in a practical sense, it is very essential to arouse desirable attitudes on the part of the pupils. Attitudes must be strong enough to cause them to want to initiate and continue to carry out specific health practices. The degree of success along this line semingly depends upon two factors. These factors are the personality of the director, and the methods of teaching he employs.

The successful director is not only an enthusiastic leader of the class as a whole, but one who takes a personal interest in each individual pupil. After the physical examination reports have been turned in, for instance, he will study them carefully. Concurrently he will observe the daily habits and practices of his pupils, and will arrange for personal conferences to further study the prevailing attitudes and habits of each child. He will then plan his class teaching accordingly, and develop thorough enough understannings of needed phases of healthful living, so that each pupil, with a little personal direction, can and will work out methods of improvement in his daily activities. If the pupil is sufficiently impressed with the need of changing his practices, he will take means to do so.

AN ATTEMPT should be made to present data in the form of scientific truths so effectively that the child will be convinced. Frequently authentic ex-

perimental reports of laboratory studies can be found which will be very impressive. In other cases, laboratory experiments can be set up in class, the pupils themselves participating, observing, and noting results. A very worth-while experiment was observed in connection with studying the effects of noise on concentration. The health teacher secured the assistance of the testing director of the school system. The class members willingly subjected themselves to reading tests given three days in succession under varying conditions: one in a quiet room; one in a room next door to a band practice; and one in a room where five or six typewriters were being used at the time. The test results were noted with much interest and caused many pupils to change their study-room conditions at home.

In another case, three pupils were sufficiently interested to verify studied reports on the effects of noise on concentration so that they, under their own initiative and unknown to the teacher, prepared their Latin lessons under varying conditions at home: first in a quiet room, and then while the radio was turned on. They reported having been able to cover more lines in the quiet room. A little later, when arranging their general study budget, these same pupils decided to study their most difficult lessons at home in a quiet room, rather than in the study room at school where there is necessarily a certain amount of confusion and noise. Other pupils in the same class arranged matters at home so that the radio would not be used by other members of the family during the study hours of the high school pupils; or the pupils arranged to get off in a room by themselves.

THE DIRECTOR should choose for solution problems that are of everyday significance; problems that touch not only the child, but the home. For example, in one class there happened to be two boys whose physical examinations revealed quite serious heart trouble. Both boys had been participating in unrestricted fashion in football and basketball. Through the health class activities, and with the cooperation of their respective doctors, physical education teachers, and the parents, the boys were informed tactfully of their condition. With the boys' cooperation, a program of activities in and out of school suitable to their defects was worked out. Since their activities in games had to be restricted, something of interest had to take their place. So in connection with the study of leisure activities in the health course these boys were acquainted with types that demand a limited amount of physical exertion, and that might be of interest to them now and also later in life. One of them finally chose photography, and the other stamp collecting. Both boys read extensively about the possibilities of their respective choices. The one who became intersted in photography has already begun to take definite instructions in the art. It may possibly result in his vocation.

Another example of helping pupils to meet life situations occurred in connection with learning to choose foods intelligently. The health director, after having taught the basic principles of correct feeding and well-balanced menus, ate with the pupils at a reserve table in their school cafeteria for a period of two weeks. Each child, after having chosen his menu, had to justify his choice on the basis of what he had learned. Criticisms by other pupils and teacher were received good-naturedly, and all seemed interested in prolonging this little game.

IN ANOTHER school, where the enrollment in the health classes was too large for the teacher to employ a similar method, the same results were attained by securing from the cafeteria manager a list of the foods to be offered the following daly, together with the price list Each child then chose on paper his foods in compliance with his under-

standing of balanced rations, taking into consideration how much money he had to spend for food, what he would probably be bringing from home in the form of sandwiches, etc., and, of course, also taking strongly into consideration his own state of health—whether under or overweight, anemic, etc. Each day, for a definite period of time, the teacher and class criticized constructively four or five of the planned menus.

Another method of arousing desirable attitudes, and initiating and establishing effective health practices, is to permit a pupil to make a project study of problems of personal significance to him. For example:

(a) While studying foods, one girl worked out how and what to feed a child of five years. She had been given the total responsibility of caring for and feeding her little brother throughout the coming summer vacation.

(b) Another girl became interested in working out a dietary for her grandfather who lived at her house. She had noticed that he did not seem to relish all foods ordinarily prepared for the family.

(c) A boy in his junior year whose medical examination revealed symptoms of Bright's disease strongly resented any restrictions on his physical activities or his dietary desires. Through the combined efforts of the health director and the mother, the boy was induced to take a research project on the causes, effects, preventions and cures of Bright's disease, with the result that he willingly and persistently observed the doctor's advice. Due to his cooperation, he was able to resume his athletic activities in his senior year.

NEON TYPE SIGNS

(Continued from page 17)

containing five cubic centimeters of mercury and neon gas at a pressure of four millimeters was mentioned. If this tube is tilted back and forth in a dark room, a red glow will be observed in the tube. This is caused by static discharges that were set up by the friction between the mercury and the glass. If your financial resources permit, a worthwhile addition can be made to the demonstration by using a transformer having an output of 8,000 volts or more. When using such a transformer, you must exercise the utmost caution not to touch the high voltage terminals when the current is flowing, as serious injury may result.

IF A VACUUM pump and a glass tube designed to be evacuated are available, the following experiment may be performed. Connect the transformer to the ends of the tube. Turn on the current. Now slowly withdraw the air. You will observe that soon a faint crimson glow will appear, then it will become brighter as the pressure becomes lower, and finally, if you succeed in reducing the pressure sufficiently, it will again become faint. The picture shows the apparatus set up for this. It is explained as follows: When the air pressure is high the transformer is not able to force ionized gas between the terminals in large enough quantities to give a brilliant light, and when the pressure is too low there is an insufficient amount of gas to give a bright light. This, of course, demonstrates the Geissler tube. Geissler tubes were energized by induction coils and these tubes may be so energized.

Commercial neon signs are usually energized with transformers and these tubes can be so energized if the terminals are connected to the transformer. You will note that they will give a much more intense light. You may even connect a number of these tubes in a series and light all of them at the same time and thus show the effects produced by the different gases. If your tubes are not equipped with terminals, you may fit them with external terminals by merely wrapping two or three turns of wire around each end of the tube. There is, however, some danger of the tubes cracking.

ACTIVITY PROGRAM IN BIOLOGY

(Continued from page 23)

ing and shelter aspects of the requirements by staging a wild-life conservation campaign in conjunction with the Jacksonville Audubon Society, wherein the students made, sold and placed white wooden T-markers eighteen inches high with a bright bird cut-out perched on top, with the words "Bird Sanctuary" on one side and "Protect Wild Life" on the other. Competition between schools became lively and the children enlarged the protective atmosphere of their own home grounds to neighborhood, and, we hope, to community proportions.

CREDIT GOES to girls who plan shopping lists and purchase family supplies, who cook meals, or take care of children in the home. We credit boys who care for lawns or home grounds, who take care of stock, or who keep pets (dogs and cats excluded except for breeding and training). These are certainly biological materials and we judge them just as developmental as learning to argue intelligently about whether there are nineteen or twenty segments in a crayfish.

We tie in with the English department in such matters as book reports, studies of the biological pastimes of famous people, and nature poems with special reference to the Florida scene. We suggest to Latin students a study of the derivation of biological terms and classic myths involving animals and plants. We interest the art students in plant and animal motifs in architecture and art. Members of the school paper may survey our two daily news sheets for a month to determine comparative space given to science items or the relation of biological items to the total science material, and so on.

IN THE FIELD of health, we seek functional outcomes. For instance, a pupil records his hours of sleep for a week, compares his averages with that of others and adds a half hour or an hour each night to his sleep. After a week or so he reports any change in his sense of well-being. We have to deal with the old story, "I can't go to sleep when I do go to bed early, so what's the use?" and lay the superstition, "I feel bad; I slept too much last night." One girl wrote: " . . I added a half hour each night to my sleep. During the first week I felt rotten, so I added another half hour. Now (end of second week) I feel fine." Whether or not this happy state of affairs become habitual, she knows from experience that she feels better when she gets enough sleep — a hard thing to make some adolescents understand. Practically all reports on this activity indicate a consciousness of increased energy and alertness. Other health activities involve experiments with diet. Among those who have tried a low-protein diet for a few weeks were two severe cases of rheumatism, both of which cleared up entirely during the experiments. Both, as confirmed by physicians' diagnoses, were cases of allergic protein-poisoning, which had not been recognized as such.

WE TRY to guide those who need it into membership in a school club where they can meet other boys and girls or develop some special talent. We are strong on hobbies: collecting, making, doing, and knowing. We encourage the development of skills, which means we give credit for dancing and music lessons; we credit almost any activity which is developmental. When the field of behavior is opened to the students, we add a long list of possible activities to our program.

The Unit on Behavior includes personality development and mental hygiene. This field involves ideals, life aims and adjustment to people, and so includes a consideration of our religious institutions, those valuable if not indispensable aids to the proper maturing of young folks. Chapters X and XIV, Curriculum Bulletin No. 1, April, 1939, Florida State Department of Public Instruction, Tallahassee, Florida, gives our activities along these lines just as we

developed them. I quote this for the benefit of teachers who may wish to obtain material in this comparatively new field. After discussing the value of working with and for people under the leadership of personalities imbued with high ideals, we give credit for participation in church, Sunday school, and young peoples' groups. In the field of personality development we have the pupils evaluate their own personality traits, then check them with an evaluation by a friend or relative. This leads to a consciousness of their use of escape and defense mechanisms, which is the first step toward a more mature attitude, and often to the discovery that their shyness looks much greater to themselves than to others. Nothing needs to be said: the shyness tends to shrink of its own accord, as a natural consequence. They enjoy Dr. Crane's "Compliment Club," and testing the extent to which one's mood is reflected in others, and they love to share the teacher's personality! We believe that this recently developed field of activity has possibilities of far-reaching consequence.

IN CLOSING, let me mention the fact that the work which our biology teachers have been doing in connection with the National Survey of Science Teaching now going on under the leadership of the Dept. of Science Instruction of the N.E.A. has been of immense help to them in orienting their viewpoints in the direction of this trend toward a greater responsibility to the individual child, which underlies the activity program here outlined, and which is perhaps the most significant feature of the program about to be published by the National Committee on Science Teaching. It is to be very strongly urged that forward-looking science teachers procure copies of the Committee's reports as soon as they appear, and act on them, for the results of this survey — the first national survey in twenty years — will dominate the field of science teaching for the next generation.

LABORATORY EPIGRAMS

(Continued from page 15)

Don't let them into the lab until they've answered a few pertinent questions — oral or written. Ask a question while they are at work. Don't answer every question the students ask during the session — they must learn to read and think. You can't do it for them.

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Old manuals contain lots of good project ideas. Don't throw them away.

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The old timers had lots of good lab ideas. Find some texts and manuals from about the turn of the century. In them you will find some good ideas for variations of the present-day standardized lab exercises.

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SIGNS IN THE laboratory do a lot of work for the teacher. Cartoons on the bulletin board are good ways to teach lab DON'TS.

A manual library in one corner of the laboratory affords a good browsing place for the better-than-average chemistry student. Let him find the extra things to do — not depend on your telling him.

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The modern fill-out laboratory manual is only as good as we make it. It should be filled out (with few exceptions) before lab time. The answers are all in the text. Try this scheme and see how much more the youngsters get out of their exercises.

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Fire drills should be anticipated. Burners out and paths set up for the exiting. All this is the teacher's responsibility.

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Consumer chemistry has always been with us. It's in the regular course if you're on the alert. The fellow that titles it as a separate branch wants to get his name in the paper.

Discipline in the laboratory is 99.9% planning and organization.

Experiment. That word should be crossed out of every high school chemistry course. We do no real experiments. They are verification exercises. We either repeat historically significant experiments or verify in the laboratory material discussed in the text. Tell your students that. Make it a part of your teaching philosophy. I'll wager that your attitude as well as that of the students will change once this concept is fully mastered. Laboratory will take on a new and forceful meaning.

BUILDING FUTURE CITIZENS

(Continued from page 19)

THE STATE health department is providing bulletins and films which may be loaned for teaching purposes, and an effort has been made to make these materials useful and usable.

Recognizing the fact that the adequate growth and development of every child depends on the coordinated and cooperative work of all professions dealing with children, the State Health Department has recently cooperated with the State Medical Association and the State Teachers Association in the establishment of the Texas Interprofession Commission for Child Development. Seventeen organizations have manifested interest in this plan. It is believed that this Commission may render real service as a coordinating agency and clearing house for all matters relating to health. Its services will be available to all agencies in Texas. It is intended to meet the great need of Texas children, to wipe out waste and duplication to the end that coordination of effort by all agencies and professions will insure to Texas children the maximum opportunity for growth and development to the end that tomorrow's citizens of Texas will serve Texas best.

SCIENCE VERSUS LIFE

(Continued from page 11)

PRACTICE OF THE JUNGLE

IF OUR AGE is "The Age of Science," our rulers, our legislators, our business men, our educators, our farmers, our factory workers should give evidence of comprehending, using, and following the scientific method. In a recent volume, the dean of Canterbury says: "Our social and economic order is neither scientific nor Christian. When I read, as a headline in the 'Observer' that Poland's good harvest was 'a severe blow to recovery,' I recalled the words of an American professor of agriculture after seeing ten million acres of cotton ploughed under and five million pigs slaughtered: 'If this will bring national prosperity, then I have wasted my life.' The thing is monstrous, an age when science is frustrated."

In the broader field of human relations, what do we see on the horizon? Conspicuous, certainly, are these: greed, force, faith, and war. These are certainly more conspicuous than the ways of reason based on scientific understanding. In the last analysis, war is murder and stealing on the part of somebody. War is the extension of the practices of the jungle into modern life. The technique of modern warfare is modified by scientific discoveries, but the elements that make for war are certainly not scientific. Hence the persistence of war cannot be laid at the door of science. It is due rather to the failure of science and conscience to as yet essentially modify human conduct. For we must assume that sooner or later reason based on understanding will modify human behavior. Even animals with no cerebrum can be conditioned. But, lest we go too far in this optimistic dogmatism, let us also remember that while we have "tamed" the dog, we have not yet "tamed" the tiger.

The scientific method demands that we suspend judgment until we know the facts. It demands honesty, integrity and industry in ascertaining the facts. The scientific method and dishonesty are incompatible. But scientists are but human beings, and they frequently make mistakes both in facts and interpretations. Now, is our age conspicuous for honesty and integrity? Is there less lying and deceit, locally, nationally, internationally, today than yesterday? The answer is all about us. Modern propaganda, and a good deal in modern advertising, have the earmarks of lying as a fine art, rather than the character of honesty, objectivity, truthfulness, and accuracy of science. It is, biologically, evident that we will have to live with greed for some time to come. But the more serious question is: can human society survive without individual, social, and national guile? If the answer is "No," we probably have here the most fundamental conflict between the scientific method and society.

SCIENCE, in spirit and method, knows no political aspects or national boundaries. Individuals of all races and nations have contributed to our present understanding of the nature of man and the universe. There is no Democratic logic, Republican mathematics, Nazi physics, Fascist chemistry, or Marxian biology. The spirit and the method of science cannot change with capitalism or socialism? This appears to me axiomatic. But fanaticism in society and governments can temporarily retard discovery and further advance in the understanding and control of life and nature. And yet we hear claims from the Germany of today of a special Teutonic or Nazi physics, claims from Russia of something called Marxian genetics, whatever that is. These and other stupidities characterize our age, but they are not the characteristics of science. If the science of modern biology has made out anything with a high degree of certainty, it is the fact of the essential unity of our present human race, and that differences as the skin color, hair color, speech, size of body, etc., are not in any way fundamental. And yet no-

tions of racial superiority and inferiority are widespread — as if the differences in skin color, size of lip or length of nose had any significance when it comes to the capacity of the brain or the control of the emotions. There are, of course, great differences in the kind and quantity of education and in the mechanical appliances due to science among the different peoples of the earth.

IF EVEN our so-called educated fellow citizens were scientific, their conduct would be more influenced by proven facts than by wishful thinking. At the recent Century of Progress Exposition in Chicago, the Adler Planetarium had a record attendance. So had the shops of the astrologers and fortune tellers on and near the exposition ground. If there is anything that has been proved to the hilt in biology and medicine during the last hundred years, it is the effectiveness of vaccination against smallpox. There are no ifs and ands about it. It is one hundred per cent effective, and practically one hundred per cent safe. Of course, wherever human hands, human agencies, are involved, accidents will happen sometimes. We can't do much, at present, to prevent colds, pneumonia, cancer, diabetes, or too high blood pressure, but we can prevent the deaths and the disabilities from smallpox by protective vaccination in early infancy. And in most cases the immunity thus conferred last throughout life. Despite all these facts, men and women in this and other civilized countries neglect and oppose vaccination against smallpox. We have large groups of people organized into "anti-vaccination societies." And these are not all ignorant people. Some are college graduates. If these people walked in the way of science, they would accept and be guided by proven facts.

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OKLAHOMA JUNIOR ACADEMY

(Continued from page 12)

the Oklahoma Academy of Science was dissolved and the name of Oklahoma Junior Academy of Science was assumed. At this meeting new officers were elected, the national Junior Academy pin was adopted, and it was agreed that correspondence with other state Junior Academies should be carried on. The fifth annual meeting of the Oklahoma Junior Academy of Science was held November 23, 1940, in Stillwater.

The Oklahoma Junior Academy of Science publishes a printed bulletin entitled "News Notes" which has appeared from time to time.

One feature begun this year is the making of a motion picture of the officers in action, the entire group in the sessions and some outstanding members and their exhibits. Next year the film will be shown as part of the program at the annual meeting.

Officers for 1940-1941:

President — Graydon Brown, Science Observers' Club, Newkirk.

Vice President—Bobby Rushing, Kiamichi Science Club, Idabel.

Secretary—Helen Jane Gilmour, Field and Stream Club, Tulsa.

Treasurer — S. H. Donnelly, Biology and Taxidermy Club, Enid.

Oklahoma Junior Academy of Science Clubs in good standing 1940-1941

Drumright — S. O. S. Club, Mildred Parker, Beulah Zimmerman, sponsors.

Enid — Biology Taxidermy Research Club, M. M. Boyer, sponsor.

Enid — Luther Burbank Flower and Garden Club, M. M. Boyer, sponsor.

Goltry — Goltry Science Club, Carrie Nickerson, sponsor.

Hallett — Hallett Junior Scientists, Maye Leonard, sponsor.

Henryetta — Archimedian Science Club, Sister Marion, sponsor.

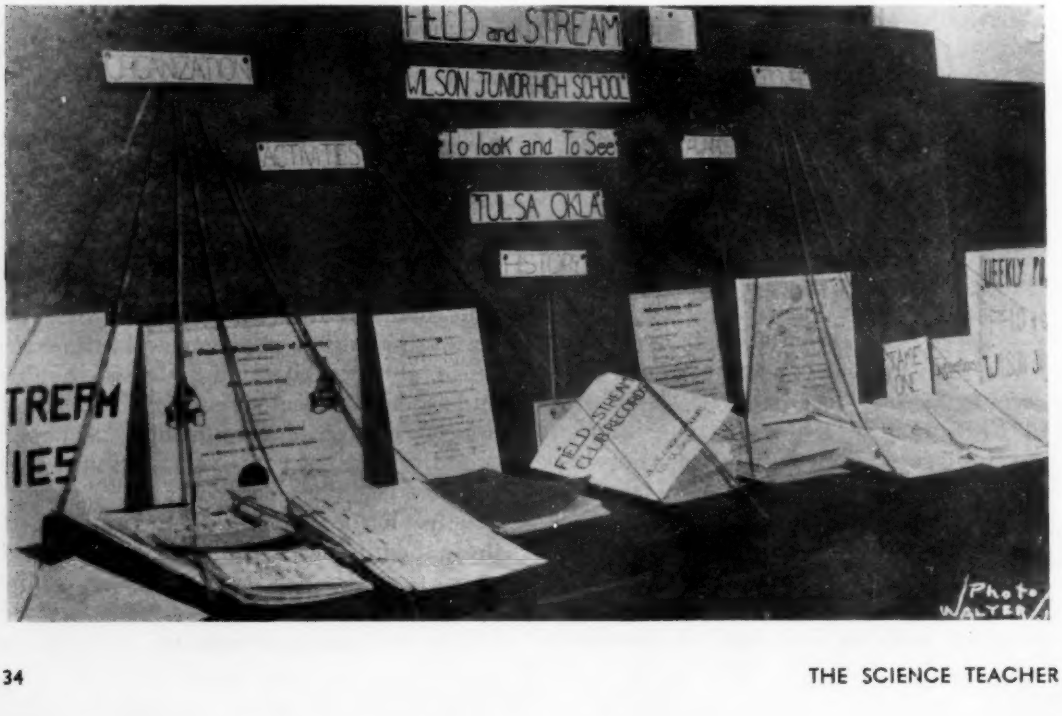
Idabel — Kiamichi Science Club, Willis W. Collins, sponsor.

Newkirk — Science Observer's Club, Jack Boyer, sponsor.

Norman—Norman Junior Academy of Science, Lewis Solomon, sponsor.

Sapulpa — Sapulpa Junior Science

Exhibit at Junior Academy of Science Meeting, Tulsa, Oklahoma



Club, Zella Breitenbacher, sponsor.

Tulsa—Field and Stream Club, Edith R. Force, sponsor.

Tulsa—Marquette Science Club, Sister Mary Lawrence, sponsor.

RAISING BUTTERFLIES

(Continued from page 13)

jars were cleaned, and larvaes fed at least once a day; sometimes twice. After the larvae pupated, the cocoons were removed to a separate jar where they remained until they hatched. Although records were kept on all of the specimens, our interest became centered on the Io, because of the great number we had. For the sake of convenience, the groups of Io larvae will be referred to as Set (A) and (B).

The record on Set (A) began on July 17th, 1940, when a female Io moth was found and placed in a fruit jar, with several elm leaves. We then began to search for more Io larvae. On September 18, 1940, twenty-one caterpillars, designated as Set (B), were found feeding on a Hybiscus plant. These larvae were about one week old, judging from Set (A). These, like the first, were a reddish-brown color with many bristles covering the back. These were also fed Wisteria leaves.

The first molt began on October 1st, seventeen days after collecting. The second molt occurred fourteen days after the first, on October 15th. The third molt began thirteen days after the second, or October 28th, and ended November 1st.

Of the twenty-one larvae, seven spun between November 3rd and November 15th. The other larvae died.

To summarize, and in conclusion: We found that the fall group of Io eggs are laid between the latter part of July and the first part of September. The larvae

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INDIVIDUAL DIFFERENCES

(Continued fro mpage 2)

of value for the slow student, the average, and the bright student, and for the farm boy as well as the city girl. In other words, experiences for the individual students regardless of the home background. This definitely points toward differentiated activities for the science classes. But these projects should not be extra assignments any more than textbooks, study, or experimental work should be extra assignments. The conclusion reached by Bimson and others representing the Educational Policies Commission in regard to out-of-classroom activities is expressed as follows:

> "There is no separation, as far as purposes, methods, and motivation are concerned, between the *best* practices of the classroom and the *best* out-of-classroom activities. In both cases, the purposes and conditions of learning are the same, and the teacher is equally responsible for desirable learning outcomes. Such differences as exist are incidental to the particular activities being carried on. Both classroom and out-of-classroom activities are parts of the school curriculum of civic education. In some schools, the two become almost indistinguishable."[1]

IT IS FELT, however, that the recommendations of the Educational Policies Commission is focused upon longtime projects and upon extraclassroom activities in which the school as a whole participates. This emphasis is laudable and will no doubt come more and more into the program of the public high schools of this country. But, under the present organization, in most high schools the out-of-the-classroom activities that are closely correlated with and a direct outgrowth of the classroom activities will offer a much greater opportunity for the application of scientific knowledge and for the adjustment to individual differences.

[1]Bimson, Oliver & Others. *Learning the Ways of Democracy*, Educational Policies Commission, 1201 Sixteenth Street, N. W. Washington, D. C., 1940, pp. 261.

The Gist of It Seems to Be

Abstracts and Reference

MANY EXCELLENT suggestions on how a science textbook must be written that will aid in teaching scientific method. — James D. Teller, "How Can Textbooks . . . Help . . . ," in S. S. & M., January, 1941. P B. S.

* * *

Here is an article we have been waiting for— how really to make a telescope, what books to buy and where to get them. — James L. Russel, "Amateur Telescope Making," in S. S. & M., January, 1941. P. B. S.

* * *

Abstract of a thesis on teaching scientific method reflectively in high school chemistry. — Arthur L. Mills, "A High School Chemistry Course Based on the Principles of Reflective Thinking," in S. S. & M., February, 1941. P. B. S.

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We need better publicity. — E. H. Brown, "The Plight of High School Physics" concluded, in S. S. & M., February, 1941. P. B. S.

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How to build an automatic headlight dimmer or depresser for your car. — Benj. Johnson, "Automatic Headlight Control for Automobiles," in S. S. & M., Feb., 1941. P. B. S.

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A DETAILED account of some excellent work in scientific method and controlled experiments in high school biology. — Ellsworth S. Obourn & Gaylord C. Montgomery, "Classroom Procedures for Developing the Elements of Problem Solving," in Sc. Ed., Feb., 1941. P. B. S.

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Generally speaking, teachers colleges do not adequately train their products in the natural sciences. — Leonard A. Ford, "Science Curricula of Teachers Colleges," in Sc. Ed., Feb., 1941.

Science is a pattern of explanation; scientific attitude is essential to cooperative enterprise; the teaching of scientific attitude is essential to problem solving, to democracy, to this dictator-ridden world. — Harold H. Punke, "Scientific Attitude and the 3 R's," in Sc. Ed., Jan., 1941. P. B. S.

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FOR A scientific method science text we need a new list of great scientists those super-great ones who developed scientific method — seven are suggested. — Philip B. Sharpe, "The Gods of Science," in Sc. Ed., Jan., 1941. P. B. S.

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Here is a simple and easy experiment that will disprove the great Myth of the Balanced Aquarium, a fiction so old and widespread that it's very existence proves our present science courses ignore scientific method and teach unscientific attitude. — Philip B. Sharpe, "Alleged Science," in The Clearing House, Jan., 1941. P. B. S.

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A THOROUGHGOING questionnaire reveals that in Biology only 53 per cent are specially prepared to teach the subject, 69 per cent have specially prepared rooms, 39 per cent have good equipment, 26½ per cent of the classes are oversized, 27 per cent of the texts are unsatisfactory, class periods are often reduced to 40 or 45 minutes, 40 per cent of the teachers are overloaded with extracurricular activities, evolution is not taught in many schools, there is a tendency to replace biology with social studies, many drift into teaching hobbies or practical applications exclusively. — Oscar Riddle, "Preliminary Impressions and Facts from a Questionnaire," in Am. Biol., Teach., Feb., 1941. P. B. S.

INSECT AND HUMAN WELFARE

(Continued from page 3)

The Insect and the Bird:

IT IS A significant fact that at least several whole families of birds are almost entirely insectivorous in their eating habits. If the insect could be exterminated entirely from the world, it would mean the simultaneous extermination of several whole families of birds. Birds surely form one of the great interests of the human in an aesthetic sense. Masses of people are attracted to birds by their vivid and beautiful colorings and by their melodious songs. Along with the aesthetic value of the birds, comes a more utilitarian value, that of food. The game laws of various states permit open seasons of various lengths on game birds which are hunted by man for food. Many of the game birds, upon which there is an open seasonfi are insectivorous in their habits. It seems self-evident that the insects furnish food for chickens, turkeys, guineas and other domestic fowls. In the final analysis of insects' relationship with birds, it would seem that the insect is truly necessary to many birds as food and, indirectly, the insect becomes necessary to man in as much as these birds become the food of man.

The Insect and Other Animals:

Innumerable animals find their partial or almost complete sustenance from insects. It is possible to mention only a few concrete illustrations to justify the above-mentioned statement. For insance, many fish feed upon insects of various kinds. Families of insects that seemingly offer food for fish include the Ephemeridae, the mayflies, the larvae of the Culicidae, the mosquito, the larvae of the Corydalidae, and the dobsonfiy, which, in its larval stage, is known as the hellgramite. Then there are certain fur-bearing animals, including the skunk and the ground hog, that are known to dig out of the earth certain insects, larvae, and pupae upon which they feed.

The Insect and Man:

THERE ARE, undoubtedly, innumerable ways that man is dependent upon the insect for his sustenance. It is now a well-known fact that certain peoples of the Orient regard the dragon fly as an extreme delicacy, quite as those of us of the Northern Temperate Zone regard shrimp or the anchovy as delicacies. A rather recent issue of a current periodical gives a detailed account of how children in the Orient go about catching dragon flies with nets and long strings upon which they string the dragon flies and upon which they allow them to partially dry so that they may be devoured sometime in the future. Man also receives a number of dyes from the insect. For instance, cachineal, which is one of the carmine dyes, is made from the pulverized bodies of the scale insect, Coccus cacti. Certain insect galls are still used by African natives as tattooing dyes. Other insect galls are used in dyeing skins, wool, and hair for garments. The insect further furnishes food for man in that the honey bee, of the genus Apis, furnishes honey. According to Metcalf and Flint, it is estimated that from 200 to 400 million pounds of honey are collected and stored annually in the United States. A by-product of the production of honey is beeswax, a natural secretion of the worker bee. Beeswax is now used in various cosmetics, such as cold creams and shaving creams, and in polishes and floor waxes. It is used extensively in making grafting wax to seal the grafting wounds.

The Insect and the Plant:

WITHOUT QUESTION, the most important role the insect plays is its relation to plants in general. Many of the plants of commerce owe their fruit development to the pollinization work of the insect. It is true that some of the grasses are cross pollinated by the wind, but many of our commercially important plants are cross pollinated by insects. Without insects, there would be

distinctly fewer apples, pears, plums, peaches, apricots, figs, et cetera; and without insects there could be no clover, for clover can be pollinated only by means of the bumble bee.

SCIENCE VERSUS LIFE

(Continued from page 33)

THE EXACT biologic relations of man to other animals are still, in part, a matter of theory. Animal evolution is usually slow. Most of what we see of it today took place in the past. We can only dimly observe the past; we cannot experiment with it. Animal evolution is probably now going on, but so slowly that we usually fail to discern it. But the essential identity of the structure and function of tissues and organs in man and animals is not a theory. It is a proven fact. The heart, the liver, the stomach, the lungs, the blood, the eyes, the ears, and even the brain are made up of the same stuff, and subjected to much the same diseases, wear and tear and ageing in man and animals. It is also true that practically ninety per cent of the understanding gained in the last hundred years of preserving health and controlling disease has been secured through experiments on animals. And yet people, even in civilized countries, oppose experiments on animals as futile and cruel, as of no benefit to man. These people are not all ignorant. But they surely are not scientific. They do not accept, they are not guided by proven facts. Their thinking and motivation have not been touched by the spirit and the method of science. Moreover, the majority of people in some of our states, through their legislatures, pass "anti-evolution" laws, as if the course of events of the past could be altered by legislative dicta of today.

(To be concluded next issue)

RAISING BUTTERFLIES

(Continued from page 35)

emerged eleven to twenty-one days after the eggs were laid. The larvae will have three to four molts, and will pupate from fifteen to eighteen days after the last molt, and it takes from thirty-five to sixty days from the time of emerging from the eggs to the pupating stage.

REFERENCES USED

1. Lutz, *Field Book of Insects.*
2. Comstock, John Henry, *Introduction to Entomology.*
3. Comstock, John Henry, *How to Know the Butterflies.*
4. Holland, W. J., *The Moth Book.*

TESLA COIL

(Continued from page 6)

around which is wound one layer of double cotton covered wire about No. 28. This is done by placing wooden discs in the ends of the cardboard cylinder. A broom stick about 42 inches in length is placed through the centers of the discs and a crank handle attached to the longer end of the broom stick. This is placed on a jig. The wire is wound on the form. It takes approximately 3200 feet of wire for an 8 inch diameter tube. The wire on the form is given two coats of shellac. This secondary coil is then placed on a circular wooden platform with a diameter greater by 2 inches than the diameter of the tube. The broom stick fits into a hole bored in the center of the platform and holds the coil on it. The upper part of the coil is connected to a brass rod with a sharp point stuck into the broom stick.

THE PRIMARY coil is built around a basket-like frame placed on the platform of the secondary coil. The eight sticks of the basket are about 10 inches long, 5/8 inches wide, and 1/2 inch thick, and are set about 30 degrees to the vertical. The sticks are set into the platform by dowels. No nails are to be used in the primary or secondary coils. Ten turns of 1/4 inch copper tubing is wound around the form, each an inch apart from the next. Eight No. 18 bare copper wire strands may be wound together by the chuck of a drill and substituted for the copper tubing. The copper tubing is held in place by notches in the wooden sticks and by cords. See the diagram of connections (page 6).

EXCLUDING the motor for the rotary tary spark gap and the transformer, the cost is practically negligible. Both may be purchased second hand for about $4.00 each. The other materials cost about $2.50. Most schools usually have the transformer and the motor.

The following demonstrations may be performed with the tesla coil:

1. When the room is darkened, the corona effects are very beautiful.

2. A spark about eight inches long may be made to jump from the brass rod to a pair of pliers held firmly in the hand.

3. A metal ball placed on the brass rod will give off a very beautiful corona.

4. A milk bottle placed on the rod will transmit a spark to a pair of plyers without breaking.

5. Neon tubes can be made to glow within five feet of the coil.

6. A 15 watt tungsten filament bulb can be lit by connecting two wires to the electrodes, holding one wire in the hand and letting a spark from the rod jump into the other wire.

7. A torch can be ignited by wrapping newspaper around a pair of plyers and letting sparks from the rod jump into the plyers.

8. A queue of people can be mildly shocked by holding the person who is drawing a spark from the rod.

9. An electric whirl can be made to turn when placed on the brass rod.

10. Letters made of metal can be made to glow when attached to the brass rod.